

balance and control, which may otherwise be lost if the wheels (or other ground-contacting members) were permitted to reach the maximum speed of which they are currently capable of being driven.

[0144] Speed limiting is accomplished by pitching the vehicle back in the direction opposite from the current direction of travel, which causes the vehicle to slow down. (As discussed above, the extent and direction of system lean determine the vehicle's acceleration.) In this embodiment, the vehicle is pitched back by adding a pitch modification to the Pitch State Estimator pitch value. Speed limiting occurs whenever the vehicle velocity of the vehicle exceeds a threshold that is the determined speed limit of the vehicle. The pitch modification is determined by looking at the difference between the vehicle velocity and the determined speed limit, integrated over time.

[0145] Alternatively, the balancing margin between a specified maximum power output and the current power output of the motors may be monitored. In response to the balancing margin falling below a specified limit, an alarm may be generated to warn the user to reduce the speed of the vehicle. The alarm may be audible, visual, or, alternatively the alarm may be tactile or may be provided by modulation of the motor drives, providing a 'rumbling' ride that is readily perceived by the user.

[0146] The automatic pitch modification sequence, in response to a detected speed at a specified speed limit, is maintained until the vehicle slows to the desired dropout speed (some speed slightly below the speed limit), and then the pitch angle is smoothly returned to its original value.

[0147] One method for determining the speed limit of the vehicle is to monitor the battery voltage, which is then used

to estimate the maximum velocity the vehicle is currently capable of maintaining. Another method is to measure the voltages of the battery and the motor and to monitor the difference between the two; the difference provides an estimate of the amount of velocity margin (or 'balancing margin') currently available to the vehicle.

[0148] The described embodiments of the invention are intended to be merely exemplary and numerous variations and modifications will be apparent to those skilled in the art. In particular, many of the controllers and methods of direction and speed control described herein may be applied advantageously to personal transporters that are not balancing personal transporters. Balancing transporters present particular requirements for combining yaw and balance controls, as discussed in the foregoing description and in U.S. Pat. No. 6,789,640. All such variations and modifications are intended to be within the scope of the present invention as defined in any appended claims.

What is claimed is:

1. A steerable personal transporter comprising:

a chassis;

two wheels mounted to the chassis;

two pivoting footplates, each of the pivoting footplates associated with one of the two wheels, each of the pivoting footplates sitting atop the chassis;

at least one sensor sensing the positions of the two pivoting footplates; and

a controller steering the transporter based at least on the positions.

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